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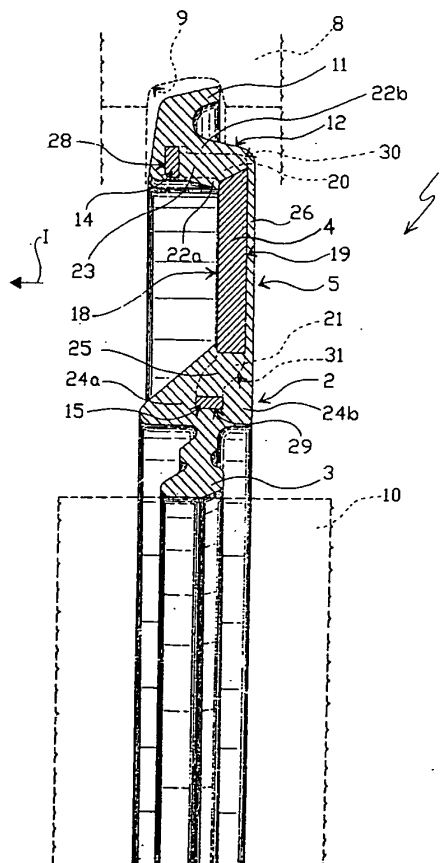
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(54) **Low-cost seal assembly and relative production method**

(57) A seal assembly (1) having an elastomeric sealing element (2), and an annular supporting structure (4) defined frontally by a first (18) and an opposite second (19) radial face, and embedded at least partly in a supporting portion (5) of the elastomeric sealing element; the supporting structure (4) having two series of perforations (20, 21) formed through the faces and arranged in respective rings at opposite, respectively outer (14) and inner (15), annular peripheral portions of the supporting structure; the supporting portion (5) of the elastomeric sealing element having first and second retaining portions (22, 24) molded, with no adhesive promoter or adhesive applied beforehand, on to both faces of the annular peripheral portions (14, 15) of the supporting structure, and connected, between the two faces, by braces (23, 25) molded through the perforations (20, 21), and, on one face, by at least one brace (26) connecting the retaining portions (22b) on the radially outer annular peripheral portion with those (24b) on the radially inner annular peripheral portion of the supporting structure.



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## Description

**[0001]** The present invention relates to, and to a method of producing, a seal assembly for insertion between two members in relative rotation, in particular the rings of a rolling bearing.

**[0002]** As is known, seal assemblies of the above type comprise an elastomeric element with sealing members, normally one or more sliding lips; and a normally metal supporting structure fitted to a supporting portion of, and for reinforcing, the sealing element to enable the lip/s to function. According to a method developed by the Applicant, the metal supporting structure is secured to the elastomeric supporting portion of the sealing element by a bonding process during curing, whereby the surface/s of the supporting structure to be fitted to the elastomeric part is/are coated with a "paint" comprising an adhesion promoter or "primer", and the elastomeric element is then molded on to the coated supporting structure in the form of a "green" i.e. not yet cured, mix. At the subsequent curing stage, the primer bonds chemically with the elastomer to achieve the desired degree of adhesion, which is superior to that obtainable using normal adhesive.

**[0003]** Though highly effective, the above method has the drawback of increasing the production cost of the seal assembly, by comprising a primer coating step, in addition to the molding/curing step which is necessary in any case. On the other hand, direct molding would not ensure sufficient adhesion of the elastomer to the supporting structure.

**[0004]** It is an object of the present invention to provide a seal assembly designed to eliminate the aforementioned drawbacks, and which, in particular, is cheap and easy to produce, is compact, and provides for relatively good sealing performance. It is a further object of the present invention to provide a low-cost method of producing such a seal assembly.

**[0005]** According to the present invention, there is provided a seal assembly comprising an elastomeric sealing element having at least one sealing member; and a supporting structure at least partly embedded in a supporting portion of said elastomeric sealing element; the supporting structure comprising a first and a second peripheral portion opposite each other, and opposite faces frontally defining said peripheral portions; characterized in that said supporting structure has first through perforations formed through said first peripheral portion, and second through perforations formed through said second peripheral portion; and in that said supporting portion of the elastomeric sealing element comprises: first retaining portions molded on to both said faces of said first peripheral portion of the supporting structure; first braces connecting the first retaining portions through said first through perforations; second retaining portions molded on to both said faces of said second peripheral portion of the supporting structure; second braces connecting said second retaining por-

tions through said second through perforations; and at least one third brace formed contacting at least one of said faces to connect said first retaining portions to the second retaining portions.

**[0006]** According to the present invention, there is also provided a low-cost method of producing a seal assembly comprising an elastomeric sealing element, and a supporting structure at least partly embedded in a supporting portion of the elastomeric sealing element; characterized by comprising the steps of:

- forming respective through perforations in a first and a second peripheral portion of the supporting structure;
- molding said elastomeric sealing element directly on to said supporting structure, without applying adhesion promoters or adhesives to the supporting structure beforehand; and
- curing said elastomeric sealing element;

said molding step being performed in such a manner as to form, on opposite faces of said peripheral portions, respective retaining portions of said elastomeric sealing element; to form, through said perforations, respective first and second braces connecting said retaining portions on the opposite faces of said first and second peripheral portion of the supporting structure respectively; and to form, on at least one of said faces, at least one respective third brace connecting the retaining portions of said first and second peripheral portion of the supporting structure.

**[0007]** This therefore provides for perfect, permanent adhesion of the elastomeric part of the supporting structure, with no need for applying primers, and with no impairment in the performance of the seal assembly, thus achieving the desired saving.

**[0008]** A non-limiting embodiment of the invention will be described by way of example with reference to the accompanying drawing showing a partial radial section of a seal assembly in accordance with the invention.

**[0009]** Number 1 in the accompanying drawing indicates as a whole a seal assembly comprising an elastomeric sealing element 2 having at least one sealing member defined, in the example shown, by a known annular lip 3; and an annular supporting structure 4 at least partly embedded in a supporting portion 5 of elastomeric sealing element 2. As shown schematically in the drawing, seal assembly 1, in use, is insertable in known manner between two members 8, 10 (shown by the dash lines) in relative motion: in the non-limiting example shown, two relatively rotating members, such as the outer and inner rings of a rolling bearing, or, more generally, a rotating seat 8 for a shaft 10.

**[0010]** In the example shown, seat 8 comprises a seat 9 for seating in static sealing manner a known peripherally outer connecting portion 11 of elastomeric element 2, projecting radially from a root portion 12 forming part of supporting portion 5.

[0011] Supporting structure 4 comprises opposite peripheral annular portions: one radially outer 14, and one radially inner 15; and opposite radial faces 18, 19 frontally defining both peripheral annular portions 14, 15. According to the invention, supporting structure 4 has a first number of through perforations 20 (only one shown) formed in a ring through radially outer portion 14; and a second number of through perforations 21 (only one shown) similar to perforations 20 and formed in a ring through radially inner portion 15 of supporting structure 4.

[0012] Combined with the above structural characteristic of supporting structure 4, supporting portion 5 of elastomeric element 2 comprises, at portion 14 of supporting structure 4, retaining portions 22a, 22b molded on to respective faces 18 and 19. Portions 22 may be continuous annular portions of elastomeric element 2, covering substantially the whole portion of faces 18, 19 defining peripheral portion 14 of supporting structure 4, or may be discontinuous annular portions of element 2, e.g. formed in a ring adjacent to perforations 20; and perforations 20 may be of any form and, in the example shown, are defined by radial slits through supporting structure 4.

[0013] According to the invention, retaining portions 22a on face 18 are connected integrally to respective portions 22b on face 19 by respective braces 23 also forming an integral part of supporting portion 5 of elastomeric element 2, and which, according to the invention, are molded directly inside and fill perforations 20. Portions 22 are formed as part of root portion 12 of connecting portion 11.

[0014] Similarly, the radially inner portion 15 of supporting structure 4 has, molded on to faces 18, 19, respective retaining portions 24 of elastomeric element 2 similar to retaining portions 22. More specifically, retaining portions 24a are molded on to face 18, and retaining portions 24b on to face 19; and portions 24a are connected to the corresponding portions 24b by respective braces 25 similar to braces 23, and which are molded inside and fill perforations 21 (similar to perforations 20).

[0015] Finally, supporting portion 5 of elastomeric element 2 comprises one or more integral braces 26, which is/are formed in contact with face 19 to connect portions 22b to respective portions 24b. If one brace 26 is provided, this will be annular to connect all of any discontinuous portions 22b to respective discontinuous portions 24b, and to cover the whole of face 19 left exposed by discontinuous portions 22b and 24b. Alternatively, to save rubber, a number of braces 26 may be formed, arranged radially in a ring to cover only part of face 19, provided each discontinuous annular portion 22b is connected to the corresponding discontinuous annular portion 24b.

[0016] According to the method of the invention, the structure described is formed by molding a green elastomeric mix directly on to the supporting structure, without applying adhesion promoters or adhesives to the

supporting structure beforehand; and then curing the mix. More specifically, the method according to the invention comprises the steps of: coining supporting structure 4 from sheet metal to form through perforations 20, 21 in respective peripheral portions 14, 15 of the supporting structure; molding elastomeric element 2, preferably by compression but also by injection, directly on to supporting structure 4 placed beforehand, with no adhesion promoter or adhesive coating, inside the mold of element 2; and curing the molded elastomeric element 2 to cross-link and set the elastomer. The molding step is performed in such a manner as to form retaining portions 22a, 22b and 24a, 24b on opposite faces 18, 19; to form relative braces 23, 25 inside perforations 20, 21; and to form brace/s 26 on face 19 to connect portions 22b to 24b. This is done simply using an appropriate mold impression, so that the liquid elastomer flows through perforations 20, 21 to form portions 22, 24, lip 3, connecting portion 11, and brace/s 26.

[0017] Preferably, peripheral annular portions 14, 15 are defined by respective annular edges 28, 29 of supporting structure 4 bent in the same axial direction; and perforations 20, 21 are formed at respective bend portions 30, 31 of respective edges 28, 29. In which case, according to the invention, braces 26 are formed on the face of supporting structure 4 facing the opposite way to the bend direction of edges 28, 29, so that edges 28, 29 (in radial section) are bent into an L and Z shape respectively, on the opposite side to face 19 and in the direction I (indicated by the arrow in the drawing) in which seal assembly 1 is inserted, in use, inside seat 8.

[0018] As stated, supporting structure 4 is made from sheet metal cut and coined to the shape described, with edges 28, 29 bent outside the plane of faces 18, 19, but may also be molded from rigid synthetic plastic. Whichever the case, while defining a substantially rigid element (as compared with elastomeric element 2), supporting structure 4 has a certain amount of radial elasticity, also by virtue of the shape of edges 28, 29.

[0019] Designed as described, seal assembly 1 according to the invention therefore ensures perfect adhesion of sealing element 2, and in particular supporting portion 5 (the stiffness and stability of which largely account for the sealing performance of lip 3) to supporting structure 4, even without adhesives or other chemical means. That is, on the one hand, pairs of portions 22a, 22b and 24a, 24b grip supporting structure 4 and are connected integrally and inseparably to it by braces 23, 25, thus ensuring connection to supporting structure 4 of lip 3 and portion 11 for connection to seat 8; and, on the other, brace/s 26 provides/provide in use, through portions 22b, 24b, for radially tensioning supporting structure 4, which may flex by virtue of the shape of edges 28, 29, while still ensuring, even without adhesive, adhesion of brace/s 26 to face 19, integral connection of supporting structure 4 and supporting portion 5, and, therefore, excellent performance of lip 3.

## Claims

1. A seal assembly (1) comprising an elastomeric sealing element (2) having at least one sealing member (3); and a supporting structure (4) at least partly embedded in a supporting portion (5) of said elastomeric sealing element; the supporting structure (4) comprising a first (14) and a second (15) peripheral portion opposite each other, and opposite faces (18, 19) frontally defining said peripheral portions (14, 15); **characterized in that** said supporting structure (4) has first through perforations (20) formed through said first peripheral portion (14), and second through perforations (21) formed through said second peripheral portion (15); and in that said supporting portion (5) of the elastomeric sealing element comprises: first retaining portions (22) molded on to both said faces (18, 19) of said first peripheral portion (14) of the supporting structure; first braces (23) connecting the first retaining portions (22a; 22b) through said first through perforations (20); second retaining portions (24) molded on to both said faces of said second peripheral portion (15) of the supporting structure; second braces (25) connecting said second retaining portions (24a; 24b) through said second through perforations (21); and at least one third brace (26) formed contacting at least one (19) of said faces to connect said first retaining portions (22b) to the second retaining portions (24b).
2. A seal assembly (1) as claimed in Claim 1, **characterized in that** said first and second braces (23, 25) are molded inside and fill said first and second perforations (20, 21); said at least one third brace (26) being molded to cover at least part of one said face (19).
3. A seal assembly (1) as claimed in Claim 1 or 2, **characterized in that** said supporting portion (5) of said elastomeric sealing element (2) is formed by molding a green elastomeric mix directly on to said supporting structure (4), without applying adhesion promoters or adhesives to the supporting structure beforehand; and by subsequently curing the mix.
4. A seal assembly (1) as claimed in any one of the foregoing Claims, **characterized in that** said supporting structure (4) and said elastomeric sealing element (2) are annular; said faces (18, 19) being substantially radial, and defining said peripheral portions (14, 15) of the supporting structure, which are also annular and located radially outwards and radially inwards respectively of the supporting structure; said first and said second perforations (20, 21) being formed in respective rings through said first and said second annular peripheral portion (14, 15) of the supporting structure.
5. A seal assembly (1) as claimed in Claim 4, **characterized in that** said first and said second annular peripheral portion (14, 15) of said supporting structure are defined by respective annular edges (28, 29) of the supporting structure, bent in the same axial direction; said perforations (20, 21) being formed in respective bend portions (30, 31) of said annular edges (28, 29).
6. A seal assembly (1) as claimed in Claim 5, **characterized in that** said at least one third brace (26) is formed on a face (19) of said supporting structure facing the opposite way to the bend direction of said annular edges (28, 29) of the supporting structure.
7. A seal assembly (1) as claimed in any one of Claims 4 to 6, **characterized in that** said first annular peripheral portion (14) of the supporting structure is defined by a radially outer edge (28) of the supporting structure bent into the form of an L in the direction in which the seal assembly is inserted, in use, inside a respective seat (8); said second annular peripheral portion (15) of the supporting structure being defined by a radially inner edge (29) of the supporting structure bent substantially into the form of a Z in said direction in which the seal assembly is inserted, in use, inside the seat.
8. A seal assembly (1) as claimed in any one of Claims 4 to 7, **characterized in that** said supporting structure (4) is coined from sheet metal.
9. A seal assembly (1) as claimed in any one of Claims 4 to 8, **characterized in that** said elastomeric sealing element (2) comprises a connecting portion (11) for connection, in use, to a seat (9) of the seal assembly; a root portion (12) of said connecting portion comprising said first retaining portions (22).
10. A low-cost method of producing a seal assembly (1) comprising an elastomeric sealing element, and a supporting structure at least partly embedded in a supporting portion of the elastomeric sealing element; **characterized by** comprising the steps of:
  - forming respective through perforations (20, 21) in a first and a second peripheral portion (14, 15) of the supporting structure;
  - molding said elastomeric sealing element (2) directly on to said supporting structure (4), without applying adhesion promoters or adhesives to the supporting structure beforehand; and
  - curing said elastomeric sealing element (2);

said molding step being performed in such a manner as to form, on opposite faces (18, 19) of said peripheral portions, respective retaining portions (22, 24) of said elastomeric sealing element

(2); to form, through said perforations (20, 21), respective first (23) and second (25) braces connecting said retaining portions (22a, 22b; 24a, 24b) on the opposite faces (18, 19) of said first and second peripheral portion (14, 15) of the supporting structure respectively; and to form, on at least one (19) of said faces, at least one respective third brace (26) connecting the retaining portions (22b; 24b) of said first and second peripheral portion (14, 15) of the supporting structure.

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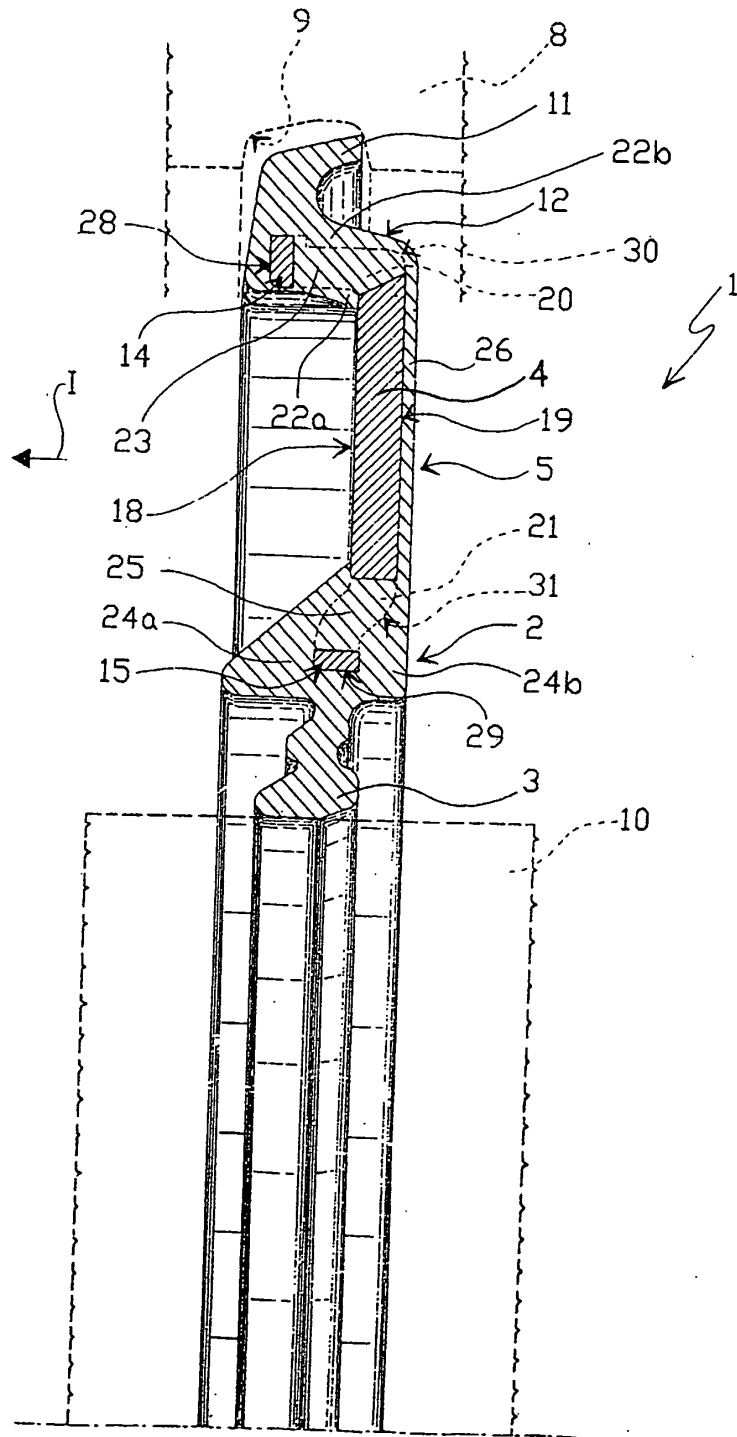
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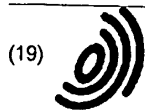
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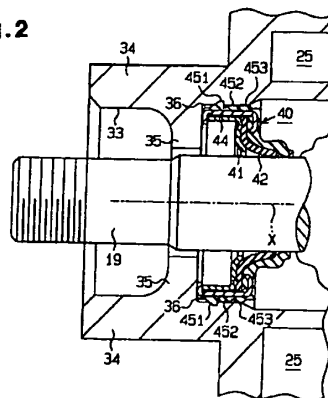
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(54) Shaft sealing structure

(57) An easy-to-install sealing unit (40) has a structure for preventing unseating. The sealing unit (40) includes a first annular elastic projection (451) and second and third elastic annular projections (452, 453). The radial dimensions (h1, h2, h3) of the three projections (451, 452, 453) are equal. An annular groove (39) is formed in the inner wall (37) of a housing. When the sealing unit (40) is press fitted against the wall (37), the second and third annular projections (452, 453) are compressed by an amount (t2, t3). The first annular projection (451) is temporarily compressed by an amount (t1) while the sealing unit (40) is being installed. When the sealing unit (40) is installed, the first annular projection (451) regains its original shape and occupies the engaging groove (39a).

Fig.2



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## EUROPEAN SEARCH REPORT

Application Number  
EP 99 10 4196

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (INCL.6)
X	US 5 329 898 A (NELSON ET AL.) 19 July 1994 (1994-07-19) * column 4, line 37 - line 68; figures *	1-10	F16J15/32
A	US 4 026 563 A (BAINARD) 31 May 1977 (1977-05-31) * abstract; figures *	1-10	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (INCL.6)
			F16J
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>25 May 2000</b>	Examiner <b>Narminio, A</b>
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**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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